

LANSCE Division
Hazard Control Plan Cover Sheet

Pressure Tests of Materials Test Loop Components		
LANSCE-3 HCP-03-001	Revision: 0	Date: 2/6/2003
Location of Work: TA-53/ MPF-18/Rm 131		Group: LANSCE-3
Authors:	Signature	Date
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Initial Risk Level: Low		
REVIEW/APPROVAL		
Reviewed by:		
Bruce Takala, LANSCE-3	<i>Bruce Takala</i>	<i>2-6-03</i>

Residual Risk Level: Minimal		
Approved by:		
Steve Wender, LANSCE-3	<i>Steve Wender</i>	<i>2/6/03</i>

HAZARD CONTROL PLAN

Activity # LANSCE-3 HCP-98-033

Liquid Lead-Bismuth Test Loop

1. Definition of Work

Operation of the lead-bismuth test loop. Lead-bismuth is melted in the melt tank, transferred to the pump sump tank and to the loop. The pump is activated to create flow in the loop. The temperatures, fluid levels and flow speeds are monitored from the computer using LabView.

2. Identification of Hazards

The hazards associated with this activity are:

1. Thermal – heaters on the melt tank, sump and the loop piping, accidental molten metal spill;
2. Electrical – power supply for the heaters, pump motor and instrumentation;
3. Chemical – lead;
4. Physical – crane use, forklift use,
5. Stored energy - pressure in the system.

Risk Evaluation

Based on LIG300-00-01.0, Safe Work Practices Implementation Guidance.

Initial Risk – MEDIUM

The control system described below has been reviewed and concurred with by
Dory Ryan, ESH-5– subject matter expert in lead handling
B. Takala, LANSCE-3 – technical peer
S. Wender, LANSCE-3 - technical peer

Residual Risk – LOW

3. Hazard Control

Task A – LOOP ASSEMBLY

Construction of the loop, its supporting, structures and enclosures. Construction of the gas and water systems. Replacing parts of the loop. Adding lead-bismuth ingots into the melt tank.

Hazard	Hazard Scenario	Hazard Controls
Physical	Crane use Lifting and moving heavy objects Using hand tools Using power tools Using forklift	Training: crane operation, forklift operation. General Laboratory housekeeping Personal Protective equipment: hard hat, goggles, safety shoes. Only qualified trained workers perform work with cranes, forklifts and power equipment

Chemical	Handling lead-bismuth ingots.	Training: lead awareness, hazard communication. Personal Protective equipment: gloves, lab coat or coveralls, goggles or face shields, safety shoes. Regulated area. Signs and postings. Designated hazardous waste storage area. Proper housekeeping.
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Comments

After handling lead one must wash his/her hands thoroughly. Do not eat, drink or apply cosmetics in the lead work area. Avoid introducing lead into the body.

Task B – LEAD-BISMUTH MELTING.

Evacuate the melt tank. After that fill the melt tank with argon and maintain pressure at about 10 psig. Start the melt tank heaters and the loop heaters. Melt the lead-bismuth in the tank and bring to specified temperature.

Hazard	Hazard Scenario	Hazard Controls
Thermal	Hot surfaces Heaters	Regulated area. Signs and postings. Protective enclosure around the heated surfaces. Automated temperature control.
Electrical	High voltage power supplies to heaters	Training: non-energized electrical worker safety. Equipment installed and serviced by qualified workers. Signs and postings.
Stored energy	Vacuum system Pressure system	Training: gas cylinder safety, pressure safety. System designed to handle operating pressures. Pressure relief valves.

Comments

At least one qualified operator must be present during operation. (See pg. 7).

Task C – LEAD-BISMUTH TRANSFER

Evacuate the loop. Slowly pressurize the melt tank with argon to transfer molten lead-bismuth into the sump and the loop up to the level of about 15in. After the transfer relieve pressure in the melt tank to about 1psig. Slowly pressurize the sump tank with argon not to exceed 18psig (the pressure relief valve set point). Check for possible leaks in the loop.

Hazard	Hazard Scenario	Hazard Controls
Thermal	Hot surfaces Molten lead-bismuth leak	Regulated area. Signs and postings. Protective enclosure around the heated surfaces. Automated temperature control.

Electrical	High voltage power supplies for heaters	Training: non-energized electrical worker safety. Equipment installed and serviced by qualified workers. Signs and postings.
Chemical	Molten lead-bismuth spill.	Training: lead awareness, hazard communication. Personal Protective Equipment when inside the enclosure: gloves, lab coat or coveralls. Regulated area. Signs and postings. Enclosed area with HEPA filtered ventilation. Operating temperature is limited to keep possible lead vapors below 10 mg/m, below OSHA limit. Two-man rule applies when the enclosure is open. Designated hazardous waste storage area. Drip pans under the loop and the melt tank.
Stored energy	Vacuum system Pressure system	Training: gas cylinder safety, pressure safety. System designed to handle operating pressures. Pressure relief valves.

Comments

At least one qualified operator must be present during operation. (See pg. 7).
When checking for leaks and spills inside the enclosure wear PPE. PPE includes lab coats, face shields, protective coveralls, gloves and safety shoes. Two-man rule must be observed.

Task D – LEAD-BISMUTH LOOP OPERATION.

Turn on the pump to circulate the molten lead-bismuth in the loop. Observe and record all temperature, pressure and flow speed data. Run the pump at different speeds as needed. Control the heaters as needed. Increase gas pressure in the sump if excessive noise or vibration from the pump is present.

Hazard	Hazard Scenario	Hazard Controls
Thermal	Hot surfaces Heaters.	Regulated area. Signs and postings. Protective enclosure around the heated surfaces. Automated temperature control.
Electrical	High voltage power supplies	Training: non-energized electrical worker safety. Equipment installed and serviced by qualified workers. Signs and postings.

Chemical	Molten lead-bismuth spill. Lead vapors from the sump tank.	Training: lead awareness, hazard communication. Personal Protective Equipment when inside the enclosure: gloves, lab coat or coveralls, face shield. 2-man rule when the enclosure is open. Regulated area. Signs and postings. Enclosed area with HEPA filtered ventilation. Operating temperature is limited to keep possible lead vapors below 10 mg/m, below OSHA limit. Designated hazardous waste storage area. Drip pans under the loop and the melt tank.
Pressure	Vacuum system Pressure system	Training: gas cylinder safety, pressure systems safety. System designed to handle operating pressures. Pressure relief valves.

Comments

At least one qualified operator must be present during operation. (See pg. 7).
During operation the two man rule has to be observed if workers need to be inside the loop enclosure. Personal protective equipment must be worn when working in the enclosure. PPE includes lab coats, face shields, protective coveralls and gloves.

Task E – LEAD-BISMUTH LOOP SHUT DOWN.

Turn off the pump. Open the valve to drain molten lead-bismuth back into the melt tank. Let the loop cool down naturally.

Hazard	Hazard Scenario	Hazard Controls
Thermal	Hot surfaces Molten lead-bismuth	Regulated area. Signs and postings. Protective enclosure around the heated surfaces. Automated temperature control.
Electrical	High voltage power supplies	Training: non-energized electrical worker safety. Equipment installed and serviced by qualified workers. Signs and postings.
Chemical	Molten lead-bismuth spill	Training: lead awareness, hazard communication. Personal Protective Equipment when inside the enclosure: gloves, lab coat or coveralls, face shield. 2-man rule when the enclosure is open. Regulated area. Signs and postings. Enclosed area with HEPA filtered ventilation. Operating temperature is limited to keep possible lead vapors below 10 mg/m, below OSHA limit. Designated hazardous waste storage area. Drip pans under the loop and the melt tank.

Pressure	Vacuum system Pressure system	Training: gas cylinder safety. System designed to handle operating pressures. Pressure relief valves.
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Comments

At least one qualified operator must be present during operation. (See pg. 7).

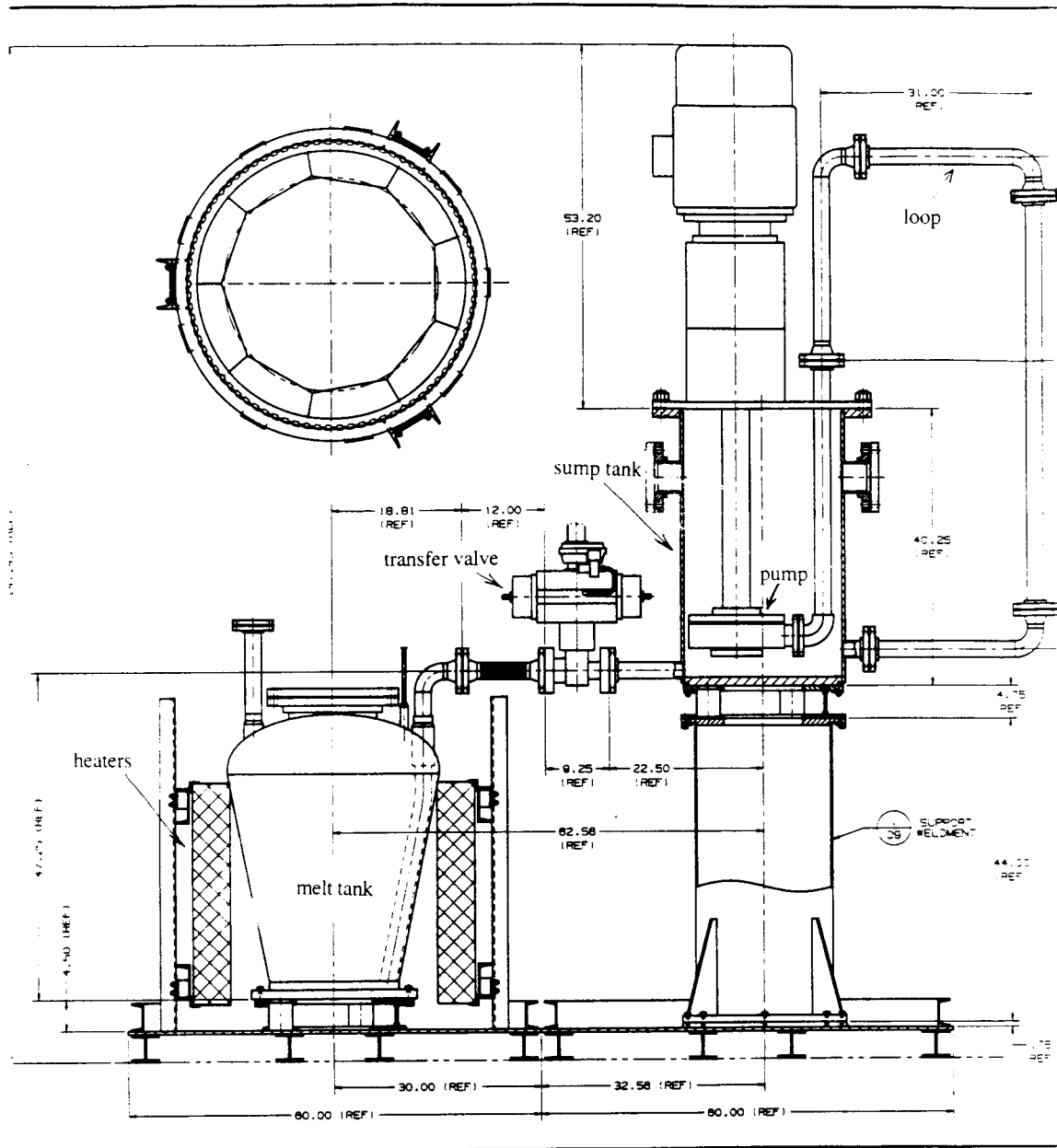


Figure 1 Schematic of the lead-bismuth loop.

TRAINING REQUIREMENTS

All operators must have completed the following

Laboratory Training:

- a. Hazard Communication Introduction.
- b. Lead awareness.
- c. Gas Cylinder Safety.
- d. Pressure Safety Orientation
- e. Non-energized electrical worker training.

The list of operators is provided on the HCP Cover Sheet.

All workers involved with this operation must have completed the following

On-the-Job Training:

- a. Read HCP and test procedure and sign the acknowledgment log (last page of this HCP).

APPLICABLE INSTITUTIONAL REQUIREMENTS

LIR 300-00-01.1, Safe Work Practices

LIR 300-00-02.1, Documentation of Safe Work Practices

LIR307-01-01.1, Safety Self-Assessment

LIR402-100-02.0, Hazardous Waste Operations and Emergency Response Training Requirements

LIR402-1110-01.1, Forklifts and Powered Industrial Trucks

LIR402-1200-01.0, Pressure, Vacuum, and Cryogenic Systems

LIR404-00-02.2 General/Waste Management Requirements

LIR404-00-03.0, Hazardous and Mixed Waste Requirements for Generators

LPR 300-00-01, Integrated Safety Management

LIG300-00-01.0, Safe Work Practices Implementation Guidance

LIG404-00-03.0, Waste Profile Form Guidance

AR 1-9, Hazard Communication

AR 8-4, Welding, Cutting, and Other Spark-/Flame-Producing Operations

AR 13-2, Cranes, Hoists, Lifting Devices, and Rigging

LS106-01.0, Chemical Hygiene Plan

LS106-03.0, Carcinogen Use

These documents can be viewed on-line at

<http://labreq.lanl.gov/hdir/labreq.html> and select “Master Index by Document Number” link.

4. Perform Work Safely

Readiness Checks and Operating Procedures

Before beginning each day’s operation do the following:

1. Check signage, post additional signs if necessary;
2. Secure enclosure;

3. Verify ventilation system is operational
4. Verify water cooling system is operational.
5. Make sure that at least one operator is present for operation of the loop.

Sample operational procedure

1. Heat lead-bismuth in the melting tank to a few degrees below the operating temperature (150-300°C) as indicated by submerged thermocouple. Set point is specified on the LabView front panel. Heat-up algorithm is executed by LabView.
2. Pre-heat the loop to operating temperature using the heater tapes. Set points on heater zones specified on the LabView front panel. May occur simultaneously with Step 1.
3. Evacuate the loop and the pump motor housing to rough vacuum (a few thousand microns). May occur simultaneously with Step 1 and Step 2.
4. Open the transfer valve using on-screen switch.
5. Pressurize melting tank with Argon until level of lead-bismuth in the sump tank is at 15 inches (approximately 12 psig in the melting tank). The level indicator thermocouples will abruptly register the LBE temperature when immersed, preceded by fast variations. The Argon fill speed should be controlled to a few scfm to prevent it from rushing into the sump tank.
6. Close transfer valve.
7. Reduce pressure in the melt tank, but keep it positively pressurized with respect to the atmosphere to prevent ingress of air. Continuously monitor the temperature of the residual Pb-Bi in the melt tank and hold at operating temperature.
8. Pressurize the sump tank to 20 psig with Argon to push molten metal into the loop. Injection of Argon gas should be gradual. Monitor the thermocouples on the loop, which would register the LBE melt temperature when the filling reaches the thermocouple locations.
9. Verify transfer with level sensor in the sump tank. The level should be about 13 inches high, and is indicated by 2nd thermocouple reading LBE melt temperature and 3rd thermocouple reading a very different temperature (usually much lower).
10. Put on PPE, as described in the Hazard Control Plan. Open the enclosure and visually inspect for possible LBE leaks. **Two-man rule applies.**
11. Close the enclosure following the inspection.
12. Turn on the pump in accordance with the manufacture's startup procedure (partial filling of the loop is allowed at startup, which is indicated by thermocouple at the top section of the loop reading temperature different (lower) than at the lower sections (melt temperature)).
13. Put on PPE, as described in the Hazard Control Plan. Open the enclosure and visually inspect for leaks and excessive vibrations. **Two-man rule applies.** If there is liquid metal flow noise (a clicking sound), increase the cover gas pressure till it goes away. There is a curve of minimum pressure vs. motor speed for no-noise (no liquid metal column cavitation) operation **in the logbook.**
14. Continuously monitor the liquid level in the sump tank and maintain loop temperature. This monitoring is software controlled.
15. Operate for predetermined duration.

At the end of daily operations do the following:

1. Turn off pump. Relieve sump overpressure. Verify liquid level in the sump.
2. Turn off all heaters.
3. Open the transfer valve and let the Lead-Bismuth drain into the melting tank by gravity.
4. Verify transfer by measuring temperature discontinuity at liquid surface in the melt tank.
5. Keep a positive pressure difference inside the melt tank during cooldown. This will need to be increased as temperature decreases.

WASTE MANAGEMENT

Waste contaminated with Lead-Bismuth is a RCRA controlled waste. There is a lead-bismuth receptacle already in place in the 'Hazardous Waste Storage Area' on the east wall of Rm. 131 (next to the loop area).

EMERGENCY PROCEDURES

SHUTDOWN CRITERIA:

The operation of the loop should be terminated (proceed immediately to Step 1, End of daily operations procedure), if any of the following conditions exist:

- 1) A leak or spill of sufficient rate or volume to constitute a significant loss of material or to require immediate repair. At the discretion of the operator(s).
- 2) Loss of system temperature control.
- 3) While operating the pump, less than 11 inches liquid level in the sump.
- 4) Excessive noise or vibration, which cannot be reduced by increasing the cover gas pressure in the sump tank. At the discretion of the operator(s).
- 5) Extensive instrumentation failure such that, in the opinion of the operator(s), the status of the loop is unknowable and possibly unsafe.

LEAD-BISMUTH SPILL PROCEDURES:

In an event of a leak or a spill in the system during operation, shut off the pump, open the transfer valve and let liquid Lead-Bismuth drain back into the melting tank. Turn off all heaters.

Small quantity: Allow the metal to cool. Collect the metal residue and place in a suitable container for recycle.

Large quantity: Cordon off the area to prevent personnel access to the hot metal. Consult with ES&H advisors to formulate a cleanup plan.

5. Review and Improvement

The review cycle for this Hazard Control Plan is One (1) year

At this time the system will be evaluated for changes in the work scope, hazards, or other conditions that warrant revision of the hazard-control system. Any significant modifications that impact the safety envelope for the activity prior to that time require updating this Hazard Control Plan and reauthorization.

Change control is accomplished by retaining a copy of this Hazard Control Plan in the LANSCE-3 HCP file.